Evaluation of the Barton 3500 ATG as an Automatic Tank Gauging System for Monthly Monitoring of Underground Storage Tanks up to 75,000 gallons

Volume 1. Final Report

Prepared For

Barton Instrument Systems, LLC

April 12, 2000

KWA

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900 S. Turnbull Canyon Road
City of Industry, CA 91745

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Preface

This report describes a third-party evaluation of the Barton 3500 ATG. The evaluation was conducted by Ken Wilcox Associates, Inc. at the North Island Naval Air Station in Coronado, California. The forms contained in this report are based on data collected using the EPA protocol "Standard Test Procedures for Evaluating Leak Detection Methods: Automatic Tank Gauging Systems", EPA/530/UST-90/006, March, 1990. The evaluation meets the requirements of the U.S. Environmental Protection Agency for Automatic Tank Gauging Systems for Monthly Monitoring of underground storage tanks up to 75,000 gallons in volume.

Volume 1 of this evaluation contains the Final Report and Volume 2 contains the Test Data. This report was prepared by Mr. Jeff Wilcox, Ken Wilcox Associates, Inc. Technical questions regarding this evaluation should be directed to Barton Instrument Systems, at (626) 961-2547.

KEN WILCOX ASSOCIATES, INC.

Jeffrey K. Wilcox

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Approved:

H. Kendall Wilcox

H. Kendall Wilcox, Ph.D., President
April 12, 2000

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1.0 Introduction

The Environmental Protection Agency requires that all tank testing equipment be capable of meeting certain performance standards. When used for Monthly Monitoring, ATGS's are required to be capable of detecting leaks of 0.2 gallons per hour (gal/h) with a probability of detection of 95% or greater. At the same time, the method must not produce false alarms (declaring a leak when the tank is tight) more than 5% of the time.

To assure that tank testing methods meet these performance standards, the EPA requires that each method be evaluated using prescribed protocols. The Barton 3500 ATG was evaluated according to the protocol "Standard Test Procedures for Evaluating Leak Detection Methods: Automatic Tank Gauging Systems", EPA/530/UST-90/006, March 1990.

2.0 Overview of Evaluation Method

The EPA protocol provides for several alternative approaches to the evaluation of ATGS's. The Standard approach utilizing testing at a specialized test facility (Option 1) was used for this evaluation. The testing for this evaluation was conducted under controlled conditions in a 50,000 gallon underground storage tank at the North Island Naval Air Station in Coronado, California.

The EPA test procedures introduce four main factors that may influence the test results: size of leak; amount of product in the tank; temperature differentials; and tank deformation. This is accomplished by testing at different product levels under various conditions where product of different temperatures is added to a partially filled test tank.

Testing was carried out using the manufacturer's normal test routine. The ATGS equipment was installed per the manufacturers installation specifications and the unit conducted testing at times which were defined by the test schedule. The leak rate reported by the ATGS was compared to the actual volume of product removed from the tank. A statistical analysis of the data was used to determine the performance characteristics of the test method.

In addition to the measurement of product levels, the equipment must also be capable of detecting an incursion of water into the tank. A series of tests are required to determine the minimum detection level and sensitivity of the ATGS to water level changes. This testing was conducted by mounting the ATGS in a test stand. Known volumes of water were added to a cylinder containing the probe assembly. The measured level changes (as reported by the ATGS) were compared with independently measured level changes and the differences were statistically analyzed to determine the precision of the tester.

3.0 Description of the Barton 3500 ATG

A complete description of the Barton system is provided on the EPA description forms in Attachment A of this report.

The Barton 3500 ATG is a scalable inventory management solution for liquid inventory control, custody transfer, tank farm operation, and reconciliation applications. The system employs a combination of back pressure, pneumatics, and solid-state temperature sensing to produce inventory information. The main components of the 3500 ATG system are:

- Tank Control Unit (TCU)
- Tank Probe Assembly
- Tank Top Junction Box

The TCU is a microprocessor-based instrument capable of monitoring up to four tanks. The system uses an LCD display/keypad to display and input information. The TCU houses the system circuitry, the Barton DPE transducer, and a series of microprocessor controlled solenoid valves. The pneumatic media used with the system is nitrogen since it is inert, dry, and readily available. Pneumatic tubing and temperature sensor cables run from the TCU manifold to the tank probe assembly.

Measurement is done by actuating solenoid valves to run back pressure charging sequences through several precisely spaced sensing tubes on the tank probe assembly. Both hydrostatic head and differential pressures are monitored by a single DPE transducer. Measurements are taken, at various points in the tank, once pressure equilibrium is attained. Spot temperature readings are obtained from the probe's integral temperature sensor(s), as recommended in API and ISO inventory standards.

The TCU's microprocessor calculates the level from the back pressure measurements by means of a liquid specific gravity relationship. These back pressure measurements are also used to determine density and the optional water bottoms. Actual volume is computed from a 1500 point (maximum) tank specific strapping table.

Temperature measurements are used in corrected volume and corrected density computations (in accordance with API and ISO standards for hydrostatic tank gauging). Mass calculations are based on these corrected measurements.

The tank probe consists of a weighted shaft suspended by a chain, sensing tubes, and one or more spot temperature sensors. The number of sensors is determined by tank height and the 3500 system configuration/options.

4.0 Description of the Testing Location

The Barton system was evaluated at the North Island Naval Air Station in Coronado, California. The tank the evaluation was conducted on was a nominal 50,000 gallon horizontal tank that contained JP-5 fuel. The tank was 154 inches in diameter and approximately 50 feet in length. The tank was located next to a nominal 40,000 gallon tank that was used as a holding tank for fuel transfers.

KWA personnel had access to the tanks throughout the evaluation. A trailer was located near the tanks which housed leak simulations equipment, a weather station, and equipment used by KWA to independently monitor product level and temperature.

Product deliveries were simulated by transferring product from one tank to another using a suction pump at delivery rates up to 100 gal/min. Temperature differentials were achieved by circulating product through an external heat exchanger as the product was pumped from the holding tank to the evaluation tank. Product passed through one half of the heat exchanger while heated or cooled water was passed through the other half. Water used in the heat exchanger was heated with a standard gas heater and cooled with ice. The flow of the hot or cold water through the heat exchanger was controlled to achieve temperature differentials of approximately ± 5 degrees F.

5.0 Leak Detection Test Results

Data from the evaluation was analyzed statistically using the procedures specified in the EPA test protocol in Section 7.1 "ATGS Leak Detection Mode". The official results and the data reporting tables are reported on the EPA forms in Attachment A of this report.

<u>Bias</u>
The bias is the average difference between measured and induced leak rates over the number of tests. It is a measure of the accuracy of the system and can be either positive or negative. A statistical calculation is performed to determine if the bias is statistically significant. If the bias is found to be significant, the bias is included in the PFA and PD calculations. For this evaluation, the bias was not significant.

<u>Calculation of P_D and P_{FA}</u>
The standard deviation of the differences between the vendor's reported leak rate and the induced leak rate is used to determine the Probability of Detection (P_D) and the Probability of False Alarm (P_{FA}). The P_D and the P_{FA} are calculated for leak rates of 0.2 gal/h using thresholds set by the vendor.

The standard deviation used to calculate the results was 0.0574 gal/h. Using a threshold of 0.1 gal/h, the P_D of a 0.2 gal/h leak is 95.3%. Using a threshold of 0.1 gal/h, the P_{FA} on a tight tank is 4.7%. Based on the results of the evaluation, the performance parameters of the Barton system exceed the requirements of the federal regulations which require that P_D be 95% or greater and P_{FA} be 5% or less.

<u>Size of Tank</u>
Testing was conducted on a tank with a nominal capacity of 50,000 gallons. The tank was 154 inches in diameter and approximately 50 feet long. Tanks of up to 1.5 times this volume or a nominal capacity of 75,000 gallons may be tested by the Barton system.

<u>Maximum Allowable Temperature Difference</u>
The temperature difference between the product that was transferred to the tank and product already present in the tank was recorded during the evaluation. The standard deviation of these temperature differences is used to determine the maximum allowable temperature difference that can be present if a test is to be conducted following a delivery. Temperature differences ranged from –5.4 deg F to +5.6 deg F with a standard deviation of 4.6 deg F. The maximum allowable temperature difference between product being transferred to the tank and product already present in the tank is ±6.9 deg F.

<u>Waiting Time After Filling</u>
The manufacturer's specified waiting time after filling the tank is 4 hours. Waiting times during the evaluation averaged 3.98 hours.

Data Collection Time Per Test

The manufacturer's specified data collection time per test is 24 hours. Data collection times during the evaluation averaged 23.90 hours.

Product Levels

Product levels during this evaluation ranged from 50 to 95% of normal operating capacity. The manufacturer recommends that testing be conducted with the product level at least 50% full.

Minimum Threshold and Minimum Detectable Leak Rate

The minimum threshold that will result in a false alarm rate of 5% can be calculated from the results reported by the system. A threshold less than the minimum threshold will result in a false alarm rate of greater than 5%. Using the minimum threshold, the minimum leak rate that can be detected with a probability of 95% can be calculated. Leak rates smaller than the minimum detectable leak rate will be detected with a probability of less than 95%.

The minimum threshold that will result in a false alarm rate of 5% is 0.098 gal/h. Using the minimum threshold of 0.098 gal/h, the minimum leak rate that can be detected with a probability of 95% is 0.197 gal/h.

6.0 Water Sensor Test Results

The water tests were conducted under laboratory conditions by adding water to a reservoir containing the probe assembly. The calculated level changes were compared with the measured level changes reported by the Barton system.

A series of 20 threshold tests and 20 incremental tests were conducted to determine the performance of the water level sensor. The point at which the water level readings begins to register was determined first, followed by incremental additions of water to determine the resolution of the water sensor.

<u>Minimum Detectable Water Level</u>
The mean value at which water was detected for the twenty minimum detectable water level tests, was 0.352 inches with a standard deviation 0.066 inches. The upper tolerance limit (TL) estimates the minimum level of water that the sensor can detect. At the 95% confidence level, the TL was determined to be 0.509 inches. Water should be detected at least 95% of the time when the water depth in the tank reaches the TL.

<u>Minimum Water Level Change</u>
The standard deviation of the 20 minimum water level change tests was 0.094 inches. The calculated minimum water level change that the water sensor can detect (after the upper tolerance level is reached) is 0.225 inches.

<u>Time to Detect a 0.20-Gallon per Hour Water Incursion</u>
The time for the Barton 3500 ATG to detect an increase in water level of 0.225 inches in a 50,000 gallon tank containing 0.509 inches is approximately 60 hours.

7.0 Conclusions

Table 1 summarizes the results of the evaluation and Table 2 contains data collected during the evaluation. The following conclusions and recommendations are based on the results of the testing described in this report.

1. The Barton system exceeds the EPA Probability of Detection requirement of 95% or higher for 0.2 gal/h leaks and the Probability of a False Alarm requirement of 5% or less for tight tanks.

2. The maximum tank size that this evaluation may be applied to is 75,000 gallons.

3. Leak detection testing must be conducted at product levels greater than 50%.

4. A stabilization period following a delivery of at least 4 hours should be allowed before conducting testing.

5. The temperature of product added to the tank must no differ more than ±6.9 deg F from that already in the tank if a leak detection test is to be conducted following a delivery.

6. The data collection time required for testing is 24 hours.

7. The Barton system is capable of detecting water level changes with a minimum level change of 0.225 inches and a threshold level of 0.509 inches.

Table 1. Summary of the Barton 3500 ATG Test Results

Basic Information	
Maximum Tank Size	75,000 gallons
Maximum Allowable Temperature Difference	±6.9 degrees F
Average Waiting Time After Filling	3.98 hours
Average Data Collection Time per Test	23.90 hours
Minimum Product Level for Testing	50%
Statistical Information	
Standard Deviation	0.0574 gal/hr
Variance	0.00330 gal^2/hr^2
Bias	None
Mean Squared Error	0.00370 gal^2/hr^2
0.2 gal/h Leak Detection	
Threshold	0.100 gal/h
Probability of False Alarm	4.7%
Probability of Detection	95.3%
ATGS Water Detection	
Minimum Detectable Water Level	0.509 inches
Minimum Detectable Water Level Change	0.225 inches
Time to Detect a 0.2 gal/hr Water Ingress	Approximately 60 hours
Supplemental Calculations	
Minimum Threshold with 5% P_{FA}	0.098 gal/h
Minimum Detectable Leak Rate with 95% P_D	0.197 gal/h

Table 2. Data and Results of the Leak Tests

Test No.	Date at Completion of Last Fill (d-m-y)	Time at Completion of Last Fill (military)	Date Test Began (d-m-y)	Time Test Began (military)	Time Test Ended (military)	Product Temperature Differential (deg F)	Nominal Leak Rate (gal/h)	Induced Leak Rate (gal/h)	Measured Leak Rate (gal/h)	Meas.-Ind. Leak Rate (gal/h)
1	29-Oct-99	1533	02-Nov-99	2000	2000	-4.7	0.0	0.000	-0.004	-0.004
2	29-Oct-99	1533	03-Nov-99	2100	2100	-4.7	0.3	-0.285	-0.238	0.047
3	01-Dec-99	1650	01-Dec-99	2005	2005	-4.4	0.1	-0.097	-0.085	0.012
4	01-Dec-99	1650	02-Dec-99	2301	2301	-4.4	0.3	-0.287	-0.207	0.080
5	01-Dec-99	1650	06-Dec-99	1319	1319	-4.4	0.2	-0.193	-0.182	0.011
6	01-Dec-99	1650	07-Dec-99	1620	1610	-4.4	0.1	-0.098	-0.136	-0.038
7	08-Dec-99	2221	09-Dec-99	0235	0235	0.0	0.2	-0.216	-0.183	0.033
8	08-Dec-99	2221	10-Dec-99	0913	0914	0.0	0.0	0.000	-0.058	-0.058
9	08-Dec-99	2221	11-Dec-99	1548	1548	0.0	0.3	-0.277	-0.365	-0.088
10	08-Dec-99	2221	12-Dec-99	2143	2143	0.0	0.1	-0.101	-0.132	-0.031
11	14-Dec-99	1800	14-Dec-99	2204	2204	5.6	0.3	-0.280	-0.383	-0.103
12	14-Dec-99	1800	15-Dec-99	2350	2340	5.6	0.2	-0.198	-0.342	-0.144
13	14-Dec-99	1800	17-Dec-99	1430	1430	5.6	0.1	-0.102	-0.164	-0.062
14	14-Dec-99	1800	18-Dec-99	1925	1923	5.6	0.0	0.000	-0.063	-0.063
15	19-Dec-99	2356	20-Dec-99	0356	0356	-1.0	0.3	-0.285	-0.339	-0.054
16	19-Dec-99	2356	21-Dec-99	0824	0825	-1.0	0.1	-0.115	-0.164	-0.049
17	19-Dec-99	2356	22-Dec-99	1433	1431	-1.0	0.2	-0.150	-0.104	0.046
18	19-Dec-99	2356	24-Dec-99	1600	1600	-1.0	0.0	0.000	0.054	0.054
19	11-Jan-00	1445	11-Jan-00	1850	1850	-5.4	0.1	-0.068	-0.119	-0.051
20	11-Jan-00	1445	13-Jan-00	1025	1025	-5.4	0.3	-0.309	-0.268	0.041
21	11-Jan-00	1445	14-Jan-00	2201	2000	-5.4	0.0	0.000	-0.052	-0.052
22	11-Jan-00	1445	16-Jan-00	0414	0414	-5.4	0.2	-0.251	-0.220	0.031
23	17-Jan-00	1617	17-Jan-00	2017	2018	5.2	0.0	0.000	-0.032	-0.032
24	17-Jan-00	1617	19-Jan-00	0416	0415	5.2	0.2	-0.157	-0.239	-0.082

Attachment A

EPA Forms for the Barton 3500 ATG for Monthly Monitoring of Underground Storage Tanks

Results of U.S. EPA Standard Evaluation
Automatic Tank Gauging System (ATGS)

This form tells whether the automatic tank gauging system (ATGS) described below complies with the performance requirements of the federal underground storage tank regulation. The evaluation was conducted by the equipment manufacturer or a consultant to the manufacturer according to the U.S. EPA's "Standard Test Procedure for Evaluating Leak Detection Methods: Automatic Tank Gauging Systems." The full evaluation report also includes a form describing the method and a form summarizing the test data. Tank owners using this leak detection system should keep this form on file to provide compliance with the federal regulations. Tank owners should check with State and local agencies to make sure this form satisfies their requirements.

ATGS Description

Name 3500 ATG

Version number ______

Vendor Barton Instrument Systems, LLC

900 S. Turnbull Canyon Road
(street address)

City of Industry,	CA	91745	(626) 961-2547
(city)	(state)	(zip)	(phone)

Evaluation Results

This ATGS which declares tank to be leaking when the measured leak rate exceeds the threshold of 0.100 gallon per hour, has a probability of false alarms [P_{FA}] of 4.7 %.

The corresponding probability of detection [P_D] of a 0.20 gallon per hour leak is 95.3 %.

The minimum water level (threshold) in the tank that the ATGS can detect is 0.509 inch.

The minimum change in water level that can be detected by the ATGS is 0.225 inches (provided that the water level is above the threshold).

Therefore, this ATGS (**X**) does ( ) does not meet the **federal** performance standards established by the U.S. Environmental Protection Agency (0.20 gallon per hour at P_D of 95% and P_{FA} of 5%), and this ATGS (**X**) does ( ) does not meet the **federal** performance standard of measuring water in the bottom of the tank to the nearest 1/8 inch.

Test Conditions During Evaluation

The evaluation testing was conducted in a 50,000 gallon (X) steel ( ) fiberglass tank that was 154 inches in diameter and 600 inches in length.

The temperature difference between product added to fill the tank and product already in the tank ranged from -5.4 deg F to +5.6 deg F, with a standard deviation of ± 4.6 deg F.

The tests were conducted with the tank product levels 50 to 95 % full.

The product used in the evaluation was JP-5 .

Name of ATGS 3500 ATG
Version ______

Limitations on the Results

The performance estimates above are only valid when:

- The method has not been substantially changed.
- The vendor's instructions for installing and operating the ATGS are followed.
- The tank contains a product identified on the method description form.
- The tank is no larger than 75,000 gallons.
- The depth of the product in the tank is at least 50 percent full.
- The waiting time after adding any substantial amount of product to the tank is 4 hours.
- The temperature of the added product does not differ more than ± 6.9 degrees Fahrenheit from that already in the tank.
- The total data collection time for the test is at least 24 hours.
- Other limitations specified by the vendor of determined during testing:

  None

> **Safety disclaimer: This test procedure only addresses the issue of the ATG system's ability to detect leaks. It does not test the equipment for safety hazards.**

Certification of Results
I certify that the ATGS was installed and operated according to the vendor's instructions and that the results presented on this form are those obtained during the evaluation. I also certify that the evaluation was performed according to one of the following:

(X) standard EPA test procedure for ATGS
( ) alternative EPA test procedure for ATGS

H. Kendall Wilcox, President
(printed name)

H. Kendall Wilcox
(signature)

April 12, 2000
(date)

Ken Wilcox Associates, Inc.
(organization performing evaluation)

Grain Valley, Missouri 64029
(city, state. zip)

(816) 443-2494
(phone number)

Reporting Form for Leak Rate Data
Automatic Tank Gauging System (ATGS)

ATGS Name and Version: Barton ATG 3500

Evaluation Period: From 29-Oct-99 to 19-Jan-00

Test No.	Date at Completion of Last Fill (d-m-y)	Time at Completion of Last Fill (military)	Date Test Began (d-m-y)	Time Test Began (military)	Time Test Ended (military)	Product Temperature Differential (deg F)	Nominal Leak Rate (gal/h)	Induced Leak Rate (gal/h)	Measured Leak Rate (gal/h)	Meas.-Ind. Leak Rate (gal/h)
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3	01-Dec-99	1650	01-Dec-99	2005	2005	-4.4	0.1	-0.097	-0.085	0.012
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6	01-Dec-99	1650	07-Dec-99	1620	1610	-4.4	0.1	-0.098	-0.136	-0.038
7	08-Dec-99	2221	09-Dec-99	0235	0235	0.0	0.2	-0.216	-0.183	0.033
8	08-Dec-99	2221	10-Dec-99	0913	0914	0.0	0.0	0.000	-0.058	-0.058
9	08-Dec-99	2221	11-Dec-99	1548	1548	0.0	0.3	-0.277	-0.365	-0.088
10	08-Dec-99	2221	12-Dec-99	2143	2143	0.0	0.1	-0.101	-0.132	-0.031
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13	14-Dec-99	1800	17-Dec-99	1430	1430	5.6	0.1	-0.102	-0.164	-0.062
14	14-Dec-99	1800	18-Dec-99	1925	1923	5.6	0.0	0.000	-0.063	-0.063
15	19-Dec-99	2356	20-Dec-99	0356	0356	-1.0	0.3	-0.285	-0.339	-0.054
16	19-Dec-99	2356	21-Dec-99	0824	0825	-1.0	0.1	-0.115	-0.164	-0.049
17	19-Dec-99	2356	22-Dec-99	1433	1431	-1.0	0.2	-0.150	-0.104	0.046
18	19-Dec-99	2356	24-Dec-99	1600	1600	-1.0	0.0	0.000	0.054	0.054
19	11-Jan-00	1445	11-Jan-00	1850	1850	-5.4	0.1	-0.068	-0.119	-0.051
20	11-Jan-00	1445	13-Jan-00	1025	1025	-5.4	0.3	-0.309	-0.268	0.041
21	11-Jan-00	1445	14-Jan-00	2201	2000	-5.4	0.0	0.000	-0.052	-0.052
22	11-Jan-00	1445	16-Jan-00	0414	0414	-5.4	0.2	-0.251	-0.220	0.031
23	17-Jan-00	1617	17-Jan-00	2017	2018	5.2	0.00	0.000	-0.032	-0.032
24	17-Jan-00	1617	19-Jan-00	0416	0415	5.2	0.20	-0.157	-0.239	-0.082

Description
Automatic Tank Gauging System

This section describes briefly the important aspects of the automatic tank gauging system (ATGS). It is not intended to provide a thorough description of the principles behind the system or how the equipment works.

ATGS Name and Version

3500 ATG

Product

> Product type

For what products can this ATGS be used? (check all applicable)

(X) gasoline

(X) diesel

(X) aviation fuel

(X) fuel oil #4

(X) fuel oil #6

(X) solvents

(X) waste oil

(X) other (list) No limitations.

> Product level

What product level is required to conduct a test?

( ) greater than 90% full

(X) greater than 50% full

( ) other (specify) ____

Does the ATGS measure inflow of water as well as loss of product (gallon per hour)?

(X) yes

( ) no

Does the ATGS detect the presence of water in the bottom of the tank?

(X) yes

( ) no

Level Measurement

What technique is used to measure changes in product volume?

( ) directly measure the volume of product change

(X) changes in head pressure

( ) changes in buoyancy of a probe

( ) mechanical level measure (e.g., ruler, dipstick)

( ) changes in capacitance

( ) ultrasonic

( ) change in level of float (specify principle, e.g., capacitance, magnetostrictive, load cell, etc.) ______________________________

( ) other (describe briefly) ______________________________

Temperature Measurement

If product temperature is measured during a test, how many temperature sensors are used?

(X) single sensor, without circulation

( ) single sensor, with circulation

( ) 2-4 sensors

( ) 5 or more sensors

( ) temperature-averaging probe

If product temperature is measured during a test, what type of temperature sensor is used?

( ) resistance temperature detector (RTD)

( ) bimetallic strip

( ) quartz crystal

( ) thermistor

(X) other (describe briefly) Solid state temperature sensor

If product temperature is not measured during a test, why not?

( ) the factor measured for change in level/volume is independent of temperature (e.g., mass)

( ) the factor measured for change in level/volume self-compensates for changes in temperature

( ) other (explain briefly) ______________________________

Data Acquisition

How are the test data acquired and recorded?

( ) manually

( ) by strip chart

(X) by computer

Procedure information

> Waiting times

What is the minimum waiting period between adding a large volume of product (i.e., a delivery) and the beginning of a test (e.g., filling from 50% to 90-95% capacity)?

( ) no waiting period

( ) less than 3 hours

(X) 3-6 hours

( ) 7-12 hours

( ) more than 12 hours

( ) variable, depending on tank size, amount added, operator discretion, etc.

> Test duration

What is the minimum time for collecting data?

( ) less than 1 hour

( ) 1 hour

( ) 2 hours

( ) 3 hours

( ) 4 hours

( ) 5-10 hours

(X) more than 10 hours

( ) variable (explain) ____

> Total time

What is the total time needed to test with this ATGS after a delivery?
(waiting time plus testing time)

_28_ hours ___ minutes

What is the sampling frequency for the level and temperature measurements?

( ) more than once per second

( ) at least once per minute

(X) every 1-15 minutes

( ) every 16-30 minutes

( ) every 31-60 minutes

( ) less than once per hour

( ) variable (explain) ____

> Identifying and correcting for interfering factors

How does the ATGS determine the presence and level of the ground water above the bottom of the tank?

( ) observation well near tank

( ) information from USGS, etc.

( ) information from personnel on-site

(X) presence of water in the tank

( ) other (describe briefly) ____

( ) level of ground water above bottom of the tank not determined

How does the ATGS correct for the interference due to the presence of ground water above the bottom of the tank?

(X) system tests for water incursion

( ) different product levels tested and leak rates compared

( ) other (describe briefly) ____

( ) no action

How does the ATGS determine when tank deformation has stopped following delivery of product?

(X) wait a specified period of time before beginning test

( ) watch the data trends and begin test when decrease in product level has stopped

( ) other (describe briefly) ____

( ) no procedure

Are the temperature and level sensors calibrated before each test?

( ) yes

(X) no

If not, how frequently are the sensors calibrated?

( ) weekly

( ) monthly

(X) yearly or less frequently

( ) never

> Interpreting test results

How are level changes converted to volume changes (i.e., how is height-to-volume conversion factor determined)?

( ) actual level changes observed when known volume is added or removed (e.g., liquid metal bar)

( ) theoretical ratio calculated from tank geometry

(X) interpolation from tank manufacturer's chart

( ) other (describe briefly) ____

( ) not applicable; volume measured directly

How is the coefficient of thermal expansion (Ce) of the product determined?

( ) actual sample taken for each test and Ce determined from specific gravity

( ) value supplied by vendor of product

( ) average value for type of product

(X) other (describe briefly) Hydrostatic pressure reading does not vary significantly with product expansion.

How is the leak rate (gallon per hour) calculated?

(X) average of subsets of all data collected

( ) difference between first and last data collected

( ) from data from last ___ hours of test period

( ) from data determined to be valid by statistical analysis

( ) other (describe) ____

What threshold value for product volume change (gallon per hour) is used to declare that a tank is leaking?

( ) 0.05 gallon per hour

(X) 0.10 gallon per hour

( ) 0.20 gallon per hour

( ) other (list) ____________________

Under what conditions are test results considered inconclusive?

( ) too much variability in the data (standard deviation beyond a given value)

( ) unexplained product volume increase

(X) other (describe briefly) Unstable pressure sensor temperature.

(Greater than ± 2 deg F from set point.)

Exceptions

Are there any conditions under which a test should not be conducted?

( ) water in the excavation zone

( ) large difference between ground temperature and delivered product temperature

( ) extremely high or low ambient temperature

( ) invalid for some products (specify) ____________________

(X) other (describe briefly) High/Low ambient temperature swing greater than

75 deg F during a 24 hour test period.

What are acceptable deviations from the standard testing protocol?

( ) none

(X) lengthen the duration of test

( ) other (describe briefly) ____________________

What elements of the test procedure are determined by personnel on-site?

( ) product level when test is conducted

( ) when to conduct test

( ) waiting period between filling tank and beginning test

( ) length of test

( ) determination that tank deformation has subsided

( ) determination of "outlier" data that may be discarded

(X) other (describe briefly) Pressure sensor temperature set point valve (10 deg F

higher than ambient temperature max).

( ) none